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Promoting Graduates' Mobility in Engineering Education: Towards Global Engineers

Guest Editors
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International mobility has been recently put forward by the European Union as "one of the main drivers of change for promoting a knowledge-based economy, for increasing social cohesion and for improving equal opportunities". However, in spite of the availability of well-established international mobility programmes (both for students, researchers and professors), internationalization opportunities are not yet generalized and their impacts are varied and linked to a wide set of factors, not always based on motivation, devotion and talent. Even traditional and successful mobility schemes face uncertainties and challenges linked to student integration, assessment strategies, coordination between centers and social and economical sustainability. In this study we try to methodically analyze the main strategies for the promotion of "International Mobility in Engineering Education", as linked to the "Global Engineers of the Future". Main actuations directly involve students or teachers (and their teaching methodologies) and take advantage of the environment and available resources. A systematic analysis of the typical problems linked to main drivers of change is performed and enables us to detect unsolved issues, which can be groups into 6 main challenges. After studying them, we put forward 24 different solutions, for short-term actuation, and discuss their effects, while bearing in mind our experience in the International Relations Office at ETSII-UPM, together with the information from the studies carried out by numerous colleagues worldwide.
Keywords: engineering education; international mobility; global engineers; education for all

Virtual mobility and communication over ubiquitous ICT channels is already having a significant share in modern business and industrial activities. Collaboration in dislocated, virtual teams, where team members have never met in person are common, daily-based activities in every larger international corporation. Due to number of various reasons, this is still not a common practice in traditional academic institutions. Large majority of subjects are still taught ex-cathedra as they were decades and centuries ago. While there is still important value in this conservative approach, it is nonetheless important to give students an experience and knowledge necessary for kick-start their careers. In this paper we present an approach for virtual collaboration and mobility in order to facilitate modern dislocated new product development process and demonstrate its value on two cases of industrial projects, which were realised by international and multidisciplinary teams of students from four different European universities.
Keywords: project based learning; new product development; virtual mobility; collaborative design process; distributed design

In this research, we implemented a new capstone framework to integrate the Daft's 4MF model and Building Information Modeling (BIM) technology in project-based teaching for student competency improvement. The operational structured management framework of BIM Capstone is critical to Construction Engineering and Management (CEM) students to synthesize knowledge contents with innovative technical support. We addressed the following extensive concerns in the design of the competency-based BIM Capstone: (1) How to develop a highly integrated CEM curriculum with the specialization in multi-mode communication and collaboration; (2) How to organize and lead the students' efforts in the final stage of their learning to encourage analysis skills and involvement; and (3) How to assess the effectiveness of experiential learning and students' ability to take responsibilities in the application of their professional knowledge. The framework included Daft's 4MF model for the definitions of competency expectations, systematic demonstration and analysis of integrated project management, CEM learning phases for the vertical correlation between the capstone learning phases, and team-based learning environment with BIM technology for knowledge integration. This research provided empirical studies to progressively draw upon a wide range of theories and dimensions to build a complex learning model which built an accessible, understandable and operable structure. The novelty of the research is the implementation of Daft's 4MF model for knowledge integration in BIM capstone.
Keywords: pedagogical design; capstone framework; Daft's 4MF model; case analysis; curriculum model

There are different proposals about technical and professional skills that an engineer should have. In the engineering education context, especially professional skills have become a critical concern on how they can be taught, and how to assess their acquisition. In this paper we present our experiences in teaching skills using a real-project-based learning approach with the collaboration of industry. We considered three proposals of skills: Software Engineering set of knowledges, the 21st Century skills philosophy, and a set of attributes for a global engineer. We take into account the three sets in order to have more specificity for identifying skills and their assessment, and to show the integral training that our students have. We expose how our proposal is similar to worldwide known educational standards such as ABET. Also, we show how this approach has contributed to the international mobility promotion of our graduates in the international job market.
Keywords: engineering education; technical and professional skills; assessment; project-based learning; industry; international mobility promotion

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Improving Sociocultural Outcomes for Students in the Higher Education
through Participation on Virtual Mobility: The UbiCamp Experience

The new challenges in international engineering education needs to go further from traditional technical skills acquisitions, allowing future engineers to easily work within international teams. To do that, the acquisition of sociocultural elements becomes an essential skill for these future engineers. Traditionally, this acquisition has been done through popular European programs such as ERASMUS programme. However, the current European context sometimes makes it difficult for students developing this kind of physical mobility. For this reason, the Virtual Mobility (VM) concept has emerged as an alternative to support the education activities, which can facilitate international experiences of collaboration and sociocultural exchanges among students. This paper presents the main results generated from UbiCamp project based on VM. The paper presents both, the formal definition of a software framework that allows to integrate traditional e-learning tools (as Moodle), with non-traditional sociocultural tools (as Virtual Worlds), and a complete Virtual World, designed and integrated in the UbiCamp framework, to provide a 3D highly immersive environment to stimulate the sociocultural immersion among students. Finally, some empirical results extracted from 60 students and 28 teachers who were involved in this VM experience, are analyzed to show the potential of VM as a tool for international mobility education.

Keywords: virtual mobility; educational technology; intercultural competences; virtual words

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Sanjay Misra
A Study on the Key Soft Skills for Successful Participation of Students in
Multinational Engineering Education

Soft-skills have proved to be a necessary complement to technical skills in today's multinational workplaces. As universities are facing the challenge of promoting internationalization and mobility in students and teachers, they have to decide how to help their students in developing these skills as well as increase their awareness on the cultural differences in multinational settings. After a long trajectory of participation in multinational educational experiences, the authors launched a survey to check if their previous findings on the preferred soft skills by educational experts and managers still remain valid after 5 years. Another goal of the study was the analysis of the link between preference for specific soft skills and cultural background in each country as characterized by Hofstede's indicators. The data collected from 123 experts from 45 different countries have confirmed the existence of a stable core set of preferred soft skills at global level and also for European countries. Results have also shown links between specific cultural indicators and preference for some soft skills.

Keywords: soft skills; student mobility; international education; Hofstede; multinational experiences

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Towards the Definition of a Global Logistics Engineer: Procedure to
Establish an International Curriculum in Engineering Education

Universities are revealed as one of the main agents to foster international mobility experiences as they are responsible for establishing the curricular itinerary of the different University careers. However, nowadays there is not still a common definition and establishment of engineer's profiles to be globally identified. This is essential in the case of Logistics Engineers because of the strategic importance of Logistics in many environments for the development of a country. The objective of this paper is to define a procedure to establish a generic logistics engineer profile at a global level. This procedure comprises three phases: (i) comparison of different training procedures of logistics in several countries; (ii) determine the practical experiences an engineer should acquire in different environments at three levels: basic knowledge, knowledge that defines profile, and specialization; and (iii) complementary education that enriches the knowledge acquired in origin. This procedure can be applied with minor changes to other engineering disciplines. The research carried out to define the logistics engineer profile includes the opinions of logistics enterprises, technological centers, and the authors' expertise in the area.

Keywords: engineering education; logistics engineer; global; curriculum; mobility

Esther Matemba and **Natalie Lloyd**
Internationalisation of Professional Engineers: A Review of Globalisation
of Engineering Education and Accreditation—Challenges from an African
Perspective

Globalisation has created demands for engineers with competencies enabling their proactive engagement in a global industry. This demand has created pressure on institutions to design engineering programs that can produce internationalised engineers with globally mobile competencies. This paper presents a review of current research in internationalisation of engineering education, with particular focus on issues of international accreditation and global applicability. With justification of the need for an international collaboration in transforming engineering education, this review highlights concerns about the applicability of a Western accreditation discourse to African countries and the efficacy of global and regional efforts towards accreditation and globalisation. The existing systems of international accreditation and reciprocity agreements are critically reviewed and concerns for internationalisation are discussed. Published issues of accreditation in higher education in Africa are assessed and opportunities for enhancement are made.

Keywords: globalisation; accreditation; reciprocity; competencies

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A Social Approach to Manage International Mobility Programmes

The GreenIT project was awarded within the Erasmus Mundus, Action 2 programme as a mobility scheme for all academic levels (185 mobilities in total) between 6 European and 4 North African countries. A special feature of GreenIT as an educational project is that only a subset of academic fields (sciences and technology) were included. Therefore, this project boosted the engineering studies in a geographical area where other fields, like archeology and humanities, have been historically prioritized. Besides, GreenIT project had faced another extra difficulty: attracting this collective to a traditional male sector. This issue was even harder because the initial concerns of North African women to go abroad alone for long periods of time and for European women to live in North African countries. However, a great success in gender equality was achieved with a 40% of female beneficiaries. Finally, this project was totally supported by a social network site for its management and coordination and, even more important, to provide a social-based platform where applicants and grantees could share their opinions, recommendations and feelings. This platform played an important role to avoid isolation, facilitate integration of grantees and encourage women to participate in the mobilities.

Keywords: international cooperation mobility programmes; Erasmus Mundus; engineering studies; gender balance; social network sites